

# Centipede communities on the inland dunes of eastern Flanders (Belgium)

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**Abstract** – During a year-round pitfall sampling campaign on twelve inland dunes in eastern Flanders, a total number of thirteen centipede species were caught. The encountered centipede fauna, with *Lithobius calcaratus* as the most ubiquitous species, was related to that of the Campine region that is also characterized by acid sandy soils. Community analysis on the basis of species composition revealed that the woody stations had a higher species diversity than the more open heath lands and moss dunes. *Brachygeophilus truncorum* and *Cryptops hortensis* were most characteristic for the woody stations whereas *Lamycetes fulvicornis* and *Lithobius microps* were more common in the open sites. © 2001 Éditions scientifiques et médicales Elsevier SAS

Belgium / Chilopoda / community analysis / sandy soils / species diversity

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## 1. INTRODUCTION

Vast areas in eastern Flanders used to consist of inland dunes. However, due to for example afforestation, sand exploitation and urbanization, only relicts of these inland dunes are left. In order to find out how these inland dunes should preferably be managed, a project was started on the invertebrates of inland dunes. One part of this project was devoted to the inventory of soil invertebrates that were sampled by means of a year-round pitfall sampling campaign. Spiders, carabid beetles, staphilinid beetles, ants, isopods and centipedes were identified [6].

Despite their importance as invertebrate predators in soil ecosystems [1, 11, 13, 18, 19], centipedes are often neglected in ecological studies and therefore only few data are available on the ecology of this group. A review of the research on Belgian centipedes for example revealed that only a few faunistic studies have been published (Lock, submitted). In the present study, the centipedes of some inland dunes in eastern Flanders were studied. The aim of the inventory was to investigate if a characteristic centipede fauna was present on inland dunes and to see if the presence of

centipedes was related to environmental variables. The obtained data are gathered in order to be able to advise nature conservationists on how these inland dunes should best be managed in order to protect the habitat of the characteristic fauna of inland dunes.

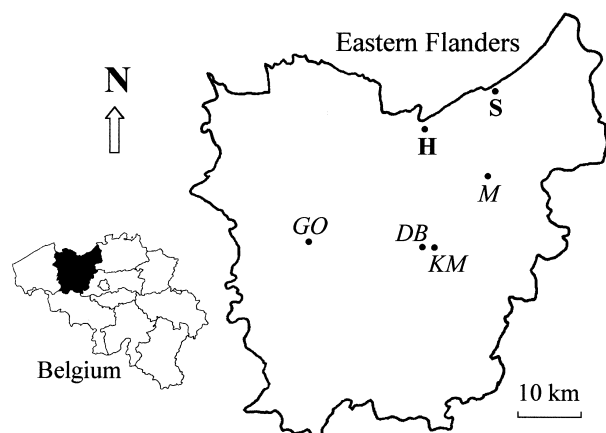
## 2. MATERIALS AND METHODS

### 2.1. Sampling

The twelve inland dunes in eastern Flanders that were sampled (*figure 1*) are listed in *table 1*. Den Blakken in Wetteren (DB) consisted of a deforested area with heath. In Sint-Martens-Latem, a very small heath land is present in the middle of a golf course (GO). A chopped poplar forest (in 1993–1994), which is heavily undermined by rabbits, was sampled in Uitbergen (KM), and in Lokeren two moss dunes were sampled (M1, M2). All the above-mentioned inland dunes originate from river dunes from the river Scheldt. Three stations in the Heidebos in Moerbeke were investigated: an open forest with heath (H1), a cart track with heath (H2) and a deforested part where bracken (*Pteridium aquilinum*) is yearly mowed (H3). In the Stropersbos in Stekene, two grasslands surrounded by forest (S1, S2), a forest edge (S3) and a recently deforested birch forest (S4) were investigated.

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**Figure 1.** Map of the inland dunes that were sampled in eastern Flanders.

Both the Heidebos in Moerbeke and the Stropersbos in Stekene are relicts of late glacial sand-ridges. Per station, five pitfall traps with a diameter of 9.5 cm were placed in a row, spaced 3 m apart. A 3.5 % formaldehyde solution was used for killing and fixation and some detergent was added to lower surface tension. Pitfalls were emptied every 2 weeks and every 3 weeks during winter. Sampling lasted from April 1999 till March 2000.

## 2.2. Environmental variables

Topsoil horizons were used for texture analysis. Soil texture was determined using laser diffraction equipment (Coulter LS 200) after drying and pre-treatment with  $\text{H}_2\text{O}_2$  (30 %) in a warm water bath at 80 °C to destroy organic matter [16]. Moisture content, expressed in percentage of the soil dry weight, was determined after drying soils at 105 °C over 3 d (ISO 11465). Acidity (pH-KCl) of the upper soil was measured using a pH electrode in a suspension of 20 g dry weight in 50 mL 1 M KCl after 2 h shaking (ISO

10390). Kjeldahl nitrogen was determined using 0.5 g dry weight with  $\text{CuSO}_4$  and  $\text{K}_2\text{SO}_4$  as catalysts using a Vapodest 60 system from Gerhardt (ISO 11261). The carbon content was measured by oxidation with potassium dichromate in sulphuric acid medium [17].

## 2.3. Statistical methods

The stations were classified into clusters according to species composition, using the classification program TWINSpan (Two-Way Indicator SPecies ANalysis) [8]. TWINSpan also yields indicator species characterizing the various assemblages. The cut-levels used in this analysis correspond to the total number of centipedes that were captured at each locality: 1 = 1–2; 2 = 3–10; 3 = > 10. To check the stability of the TWINSpan results, the detrended correspondence analysis (DCA) option from the program package CANOCO [15] was applied on the log-transformed data. A log-transformation was applied prior to DCA to normalize the data. A detrended canonical correspondence analysis (DCCA; [15]) was applied to determine which environmental parameters were responsible for the difference in species composition.

## 3. RESULTS

### 3.1. Environmental variables

The sampled inland dunes are characterized by a low pH ranging from 3.4 to 4.7 and a low clay content with a maximum of 15 % clay (*table 1*). Litter thickness and percent carbon and nitrogen were higher in the forested sites and the heath lands compared to the grasslands and the moss dunes; however, these differences were not significant.

### 3.2. Centipede species

A total of 1 421 centipedes belonging to thirteen species were caught during the year-round pitfall

**Table 1.** List of the sampled inland dunes with indication of the used abbreviations, locality, community, UTM-codes and the soil characteristics: pH-KCl, litter thickness (L), clay content, humidity (H), carbon (C) and Kjeldahl nitrogen (N).

Abbr.	Locality	Community	UTM	pH	L (mm)	Clay (%)	H (%)	C (%)	N (%)
DB	Den Blakken	Wetteren	ES6351	4.0	2	11	68	4.0	0.24
GO	Golf course	St-Martens-Latem	ES4352	3.9	36	11	65	7.2	0.34
KM	Kalkense Meersen	Uitbergen	ES6551	4.7	1	8	57	3.0	0.17
M1	Molsbergen	Lokeren	ES7162	4.4	1	9	61	3.0	0.18
M2	Molsbergen	Lokeren	ES7162	4.4	0	15	55	1.7	0.13
H1	Heidebos	Moerbeke	ES6370	4.0	10	10	66	5.8	0.36
H2	Heidebos	Moerbeke	ES6370	4.4	16	7	61	3.1	0.17
H3	Heidebos	Moerbeke	ES6371	3.9	3	6	61	4.1	0.15
S1	Stropersbos	Stekene	ES7477	4.7	2	9	70	2.9	0.18
S2	Stropersbos	Stekene	ES7477	4.3	24	13	68	5.4	0.20
S3	Stropersbos	Stekene	ES7477	3.4	54	10	70	8.8	0.50
S4	Stropersbos	Stekene	ES7577	3.5	17	8	71	6.2	0.31

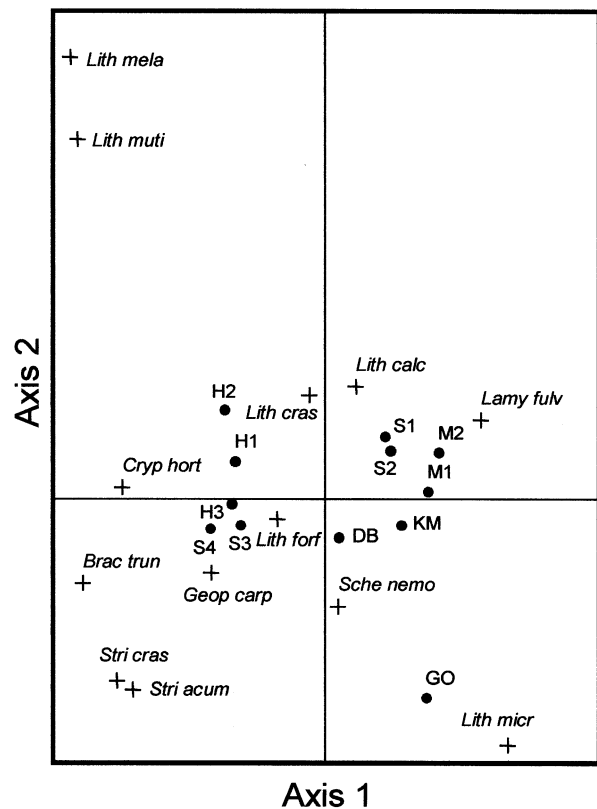
sampling campaign on twelve inland dunes. The most ubiquitous species of the inland dunes was *Lithobius calcaratus* which was only absent in the heath relict on the golf course of Sint-Martens-Latem. *Lamyctes fulvicornis* was caught most frequently but the species was only common in the open habitats such as the grasslands and the moss dunes. Other species that were often present, but mostly in low numbers, were *Lithobius forficatus*, *L. crassipes*, *L. microps*, *Cryptops hortensis*, *Brachygeophilus truncorum*, *Geophilus carpophagus*, while *Schendyla nemorensis*, *Lithobius muticus*, *L. melanops*, *Strigamia acuminata* and *S. crassipes* were represented by only a few individuals. Most species were present during the whole year without marked seasonal differences, which is not surprising since most centipedes have a life-span of several years. However, *Lamyctes fulvicornis*, which is a parthenogenetic species with a life cycle completed within a few months [20], reached the highest densities in summer while the species was absent during winter.

### 3.3. Community analysis

The results of the TWINSpan are presented in table II. In the first division, the woody stations with a higher species richness are separated from the more open sites. The indicator species for the woody stations was *Brachygeophilus truncorum* (cutlevel 1). *Cryptops hortensis* also reached the highest densities in the woody stations while *Lamyctes fulvicornis* and *L. microps* were more common in the open stations. In the subsequent division, the forested stations are separated into an open forest with heath (H1) and a cart

**Table II.** TWINSpan table (cutlevels correspond to the total number of centipedes captured on each locality : 1 = 1–2; 2 = 3–10; 3 = > 10). Abbreviations of localities are explained in table I.

	Localities				
	HH	SHS	SSMMKG	D	B
	21	433	1221MO		
<i>Strigamia acuminata</i> (Leach, 1814)	--	--1	-----	-	-
<i>Strigamia crassipes</i> (Koch, 1825)	--	--11	-----	-	-
<i>Brachygeophilus truncorum</i> (Bergsøe & Meinert, 1886)	11	232	-----	-	-
<i>Cryptops hortensis</i> (Leach, 1814)	33	333	1-----	-	-
<i>Lithobius muticus</i> (Koch, 1847)	21	---	-----	-	-
<i>Lithobius melanops</i> (Newport, 1845)	1-	---	-----	-	-
<i>Geophilus carpophagus</i> (Leach, 1814)	22	312	11---1	-	-
<i>Lithobius forficatus</i> (Linnaeus, 1758)	21	232	-1--2-	3	-
<i>Lithobius crassipes</i> (Koch, 1862)	22	-21	--112-	-	-
<i>Schendyla nemorensis</i> (Koch, 1837)	-1	223	-1-23-	-	-
<i>Lithobius calcaratus</i> (Koch, 1844)	33	232	23231-	1	-
<i>Lamyctes fulvicornis</i> (Meinert, 1868)	--	-12	33333	-	-
<i>Lithobius microps</i> (Meinert, 1868)	--	---	--1332	1	-
	00	000	111111	1	-
	00	111	000000	1	-
	01	011	000111	-	-
		01	001001	-	-
			01 01	-	-



**Figure 2.** Biplot of the sample scores and the species scores (detrended correspondence analysis).

track with heath (H2) with *Lithobius muticus* (cutlevel 1) as an indicator species on the one hand and a deforested area where bracken (*Pteridium aquilinum*) is yearly mowed (H3), a forest edge (S3) and a recently deforested woodland (S4) on the other hand. For the open sites, the deforested area with heath Den Blakken (DB) that only contained three species was separated from the other stations with *Lithobius forficatus* (cutlevel 3) as an indicator species. The DCA seemed to justify the division into woody stations (H1, H2, H3, S3, S4) and the more open stations (S1, S2, M1, M2, KM, GO) while Den Blakken (DB) was plotted between those two clusters (figure 2). The plot of the DCCA greatly differed from the DCA, which indicates that the difference in species composition could not be explained by the measured environmental variables.

### 4. DISCUSSION

In the present study, the number of individuals sampled with the pitfall traps was ten times higher for Lithobiomorpha (including the genera *Lithobius* and *Lamyctes*) compared to Geophilomorpha (including the genera *Strigamia*, *Brachygeophilus*, *Geophilus* and *Schendyla*). According to Blower [5], large lithobiids

prefer the litter layer whereas small lithobiids and geophilomorphids occur mostly in the deeper layers (especially the blind geophilomorphids with their long bodies and many legs are adapted to life in the soil where they prey upon earthworms, enchytraeids and fly larvae [2, 5]). Therefore, the relative density of the geophilomorphids is probably underestimated in the present study.

Despite the location of the inland dunes sampled, the centipede fauna occurring on these is more comparable to that of the forests in the Campine region than to that of the forests in the rest of Flanders [10]. This is probably due to the similar soil type: just as in the Campine region, the inland dunes are characterized by acid sandy soils. In addition, the centipede community fauna of some oak-hornbeam forests on sandy soils in north-west Westphalia (Germany) was comparable to that of the inland dunes but somewhat richer [7]. Due to their eurytopic nature, all the species present on the inland dunes are ubiquitous in Belgium [9], the Netherlands [4], Luxembourg [12], Germany [14] and Great Britain [3].

If management of inland dunes should be based on centipede diversity, the development of woody areas would be preferred. However, centipedes are predominantly woodland animals and for other invertebrates, heath lands of moss dunes will probably be much more interesting. As only centipede species that are quite common in Belgium [9] were encountered on the inland dunes, no special conservation measurements are necessary to protect these inland dune centipedes and, therefore, the occurrence of other invertebrates will be decisive to evaluate which management practices are preferred.

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